

Force of habit: Stress hormones switch off areas of the brain for goal-directed behaviour

25 July 2012

Cognition psychologists at the Ruhr-Universität together with colleagues from the University Hospital Bergmannsheil (Prof. Dr. Martin Tegenthoff) have discovered why stressed persons are more likely to lapse back into habits than to behave goal-directed. The team of PD Dr. Lars Schwabe and Prof. Dr. Oliver Wolf from the Institute for Cognitive Neuroscience have mimicked a stress situation in the body using drugs. They then examined the brain activity using functional MRI scanning. The researchers have now reported in the *Journal of Neuroscience* that the interaction of the stress hormones hydrocortisone and noradrenaline shut down the activity of brain regions for goal-directed behaviour. The brain regions responsible for habitual behaviour remained unaffected.

In order to test the different [stress hormones](#), the cognition [psychologists](#) used three substances - a placebo, the stress hormone hydrocortisone and yohimbine, which ensures that the stress hormone noradrenaline stays active longer. Part of the volunteers received hydrocortisone alone or just yohimbine, others both substances. A fourth group were administered a placebo. Altogether, the data of 69 volunteers was included in the study.

In the experiment, all participants - both male and female - learned that they would receive cocoa or [orange juice](#) as a reward if they chose certain symbols on the computer. After this learning phase, volunteers were allowed to eat as many oranges or as much chocolate pudding as they liked. "That weakens the value of the reward", explained Schwabe. "Whoever eats chocolate pudding will lose the attraction to cocoa. Whoever is satiated with oranges, has less appetite for orange juice." In this context, goal-directed behaviour means: Whoever has previously eaten the chocolate pudding, chooses the symbols

leading to cocoa reward less frequently. Whoever is satiated with oranges, selects less frequently the symbols associated with orange juice. Based on previous results, the scientists assumed that only the combination of yohimbine and hydrocortisone attenuates goal-directed behaviour. They have now confirmed this hypothesis.

As expected, volunteers who took yohimbine and hydrocortisone did not behave goal-directed but according to habit. In other words, satiation with oranges or chocolate pudding had no effect. Persons who had taken a placebo or only one medication, on the other hand, behaved goal-directed and showed a satiating effect. The brain data revealed: The combination of yohimbine and hydrocortisone reduced the activity in the forebrain - in the so-called orbitofrontal and medial prefrontal cortex. These areas have been already previously associated with goal-directed behaviour. The [brain regions](#) which are important for habitual learning, on the other hand, were similarly active for all volunteers.

More information: L. Schwabe, M. Tegenthoff, O. Höffken, O. Wolf (2012): Simultaneous glucocorticoid and Noradrenergic activity disrupts the neural basis of goal-directed action in the human brain, *Journal of Neuroscience*, [doi: 10.1523/JNEUROSCI.1304-12.2012](https://doi.org/10.1523/JNEUROSCI.1304-12.2012)

Provided by Ruhr-Universitaet-Bochum

APA citation: Force of habit: Stress hormones switch off areas of the brain for goal-directed behaviour (2012, July 25) retrieved 20 October 2021 from <https://medicalxpress.com/news/2012-07-habit-stress-hormones-areas-brain.html>

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